Docket No.: 30652/011A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
PROVISIONAL APPLICATION FOR UNITED STATES LETTERS PATENT

Title:

SECURE COORDINATE IDENTIFICATION METHOD, SYSTEM AND PROGRAM

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DESCRIPTION

CROSS-REFERENCE TO RELATED APPLICATIONS:

[0001] The present application claims the benefit of provisional application number 60/357,119, filed in the United States Patent Office on March 24, 2003.

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT:

[0002] Not Applicable.

TECHNICAL FIELD:

[0003] This invention generally relates to processing data and, more particularly, to the identification, processing, and comparison of location coordinates in a confidential and anonymous manner.

BACKGROUND:

[0004] Identifying and sharing a location of an item (e.g., individual, personal property, or real property) in a confidential manner is an important goal in various situations. For example, United States army personnel may have identified the location of a first target and may wish to determine whether a second target identified by a foreign army's personnel is the same in a greater effort of coordinating strike options, while at the same time not disclosing: (a) to the foreign army's personnel the location of the first target if the second target is not the same, (b) to the United States army personnel the location of the second target if the second target is not the same as the first target and/or (c) to any third person either the United States army personnel's knowledge of the first target or the foreign army's personnel's knowledge of the second target.

[0005] However, there are no existing systems that use a cryptographic algorithm to identify, disclose and compare location coordinates

representing the locations of particular items in a secure and confidential manner.

[0006] The present invention is provided to address these and other issues.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0007] FIG. 1 is a functional block diagram of the system in accordance with the invention;

FIG. 2 is a functional block diagram of the System block of FIG. 1; and,

FIG. 3 is a representation of a non-uniform grid system.

DETAILED DESCRIPTION:

[0008] While this invention is susceptible of embodiment in many different forms, there is shown in the drawing, and will be described herein in detail, specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

[0009] A data processing system 10 for processing data is illustrated in FIG. 1. The system 10 includes at least one conventional computer 12 having a processor 14 and memory 16. The memory 16 is used both for storage of the executable software to operate the system 10 as well as for storage of the data in a database and random access memory. All or part of the software may be embodied within various applications and equipment, depending upon the relevant confidentiality and security requirements. For example, the software may be embodied, stored or provided on any computer readable medium utilizing any of the following, at a minimum: (a) an installed software application on the source system, (b) a box unit that self-destroys the unit upon any tampering, and/or (c) a CD, DVD, floppy disc or other removable media. The system 10 may effect all or part of the processing of the item

location data on one or more computers 12 at the source location and/or may effect all or part of the processing with one or more computers 12 at a location different from the source (e.g., a central processing system).

[0010] To keep the item location more secure, the item location data can be encrypted. However, due to the nature of the mathematics, when values are processed, for example, by encryption or hashing, and are compared to another location data, there will only be a match when the two item location data being compared match identically. That is, data of two item locations that vary by only one unit of measurement will not be identifiable as having a potential relationship.

[0011] To overcome this potential misidentification, a system can determine a fixed coordinate grid point corresponding to the item location, with the fixed coordinate grid point then processed for use in the comparison process. This ensures that the encrypted values are matchable to previously stored data (i.e. previously stored fixed coordinate grid points). However, this raises the possibility that two item locations that are close enough to warrant a match may be assigned to two different fixed coordinate grid points and would fail to match after being processed.

[0012] Assigning the item location to more than one fixed coordinate grid point addresses the issue of incorrectly failed matching. By determining more than one of the nearest fixed coordinates to a given item location and using each in a comparison process, failed matches can be reduced. When each of the fixed coordinate grid points is processed, a set of results is available for comparison. If any element of the set matches with known data, the item location may be worthy of further investigation.

[0013] As illustrated in FIG. 2, in a step 18 the system 10 receives data representing the location of a particular item (e.g., natural person, organization, chemical compound, organic compound, protein, biological structure, biometric value, atomic structure, inventory item, real property, personal property). In a step 20 the system then determines a plurality of fixed coordinates that represent the location by several processes, for

example, rounding or comparison to a predetermined grid. Rounding calculates values on a virtual grid based upon the location. Comparing the location to the pre-determined grid finds the nearest and/or surrounding fixed coordinates. The pre-determined grid may be uniform (e.g., equal spacing between grid points), non-uniform (e.g., equal spacing in a first portion of grid points, but differential spacing in a second portion of grid points), multiple, tiered and/or three-dimensional, four dimensional or more multi-dimensional. For example, where the data representing the location consists of latitude (x), longitude (y), height (z) and time (t) variables, the system in a multiple grid circumstance compares the data to a four-dimensional non-uniform grid representing latitude, longitude, height and time dimensions to establish a plurality of fixed coordinates which would also allow for comparisons of moving targets.

[0014] While the embodiment can use just two fixed coordinates, using only two fixed coordinates creates a greater possibility that two item locations, which may be infinitesimally close to each other, may be determined to be near separate pairs of fixed coordinates. For example, the two fixed coordinates corresponding with one of the two item locations are determined to be different, and perhaps significantly farther from the two fixed coordinates corresponding with the other of the two item locations. As such, the grid would preferably have at least three (3) fixed coordinates (creating a triangle-type shape if lines were to connect the fixed coordinates on the grid), with scaled positioning of other coordinates through the grid based upon a user-defined criterion, such as spacing of a particular distance or time (e.g., one (1) minute) and potentially subdividing the coordinates according to quantity (e.g., population density). In addition, the coordinates may cover a several areas or layers, for example, the system can determine the nearest three fixed coordinates and an additional three fixed coordinates surrounding those, creating a broader matching region.

[0015] Several grids and grid combinations may be used in determining fixed coordinates. For example, an item location on a rectangular grid could be assigned to the three nearest grid coordinates.

Similarly, an item location could be assigned to all the coordinates of the grid encompassing the item location. Both of these examples involve simple geometric and trigonometric calculations. When the grid system is more complex, as discussed above, these simple techniques may not be sufficient.

[0016] Referring briefly to FIG. 3, an illustration of a non-uniform grid system 30 is shown. The non-uniform grid system 30 has a plurality of triangular grids that may relate to population density, terrain features or other criteria. Coordinates x, y, z, m, n, o, p, q, represent a plurality of fixed coordinates. Item location A is within a bounding triangle defined by the fixed coordinates x, y and z. The closest fixed grid points are, in this case, x, y and z, which would be used for comparison with previously stored data. It can be seen that point B, while within a bounding triangle m, n, o, may actually be closer to fixed coordinates outside that bounding triangle, such as points x, z and q. If so, point B, when using nearest fixed coordinates, would be associated with the fixed coordinate grid points x, z and q when being compared to previously stored data. Point C appears closest to point m of its bounding triangle m, o, p. The system, if using nearest fixed coordinates, can use mathematical evaluation to determine the other two fixed coordinates closest to C.

[0017] The use of more complex mathematics can help ensure that the most relevant fixed coordinates represent an item location, particularly in the case of non-uniform or high-dimension grid systems. One useful technique is the affine transform, which allows transformation to a coordinate system that preserves linearity and spacing. A high level overview of the use of an affine transform in this respect is illustrated below.

[0018] By way of a detailed example of one embodiment of how the system determines 20 three (3) fixed coordinates that represent the location, given a uniform triangular grid with spacing of one (1) minute, the system processes data by: (a) taking a given (x, y) where x is longitude and y is latitude in degrees corresponding to the location, (b) multiplying the given (x, y) by sixty (60) to scale to minutes, (c) taking an affine transformation $(x', y') = (x - \frac{1}{2}y, y)$, which transforms the uniform triangular grid into a uniform

rectangular grid (i.e., creating a rectangle-type shape if lines were to connect four (4) fixed coordinates on the uniform rectangular grid) and enabling the point (x', y') to fall within the uniform rectangular grid that corresponds to two (2) three fixed coordinate areas in the uniform triangular grid, (d) set (x_0, y_0) = ($\lfloor x' \rfloor$, $\lfloor y' \rfloor$) to establish the lower left corner on the uniform rectangular grid, (e) set $P_1 = (x_0 + 1, y_0)$ and $P_2 = (x_0, y_0 + 1)$ to determine two (2) fixed coordinates on the uniform rectangular grid, (f) calculate $(x' - x_0) + (y' - y_0)$ to determine a third fixed coordinate on the uniform rectangular grid, which, depending upon whether the third fixed coordinate is in the top right or lower left area of the uniform rectangular grid, is $P_0 = (x_0+1, y_0+1)$ if the result of the calculation is greater than 1 or $P_0 = (x_0, y_0)$ if the result of the calculation is less than 1, (g) transform the resulting three (3) fixed coordinates back to the uniform triangular grid by applying the affine transformation $(x', y') = (x + ½y, y)$ to each of P_0, P_1 and P_2 (which may be implemented using integers), resulting in an integral number of half minutes, which may be converted to a number from 0 to 43199 to take into account the international date line, and P_0, P_1 and P_2 being the three (3) nearest fixed coordinates on the uniform triangular grid representing the location.

[0019] The system then: (a) processes each of the plurality of fixed coordinates through a cryptographic algorithm (e.g., encryption, encoding, one-way function such as MD-5) to render the plurality of fixed coordinates confidential ("Processed Coordinates") in step 22 and (b) compares the Processed Coordinates to secondary data (e.g., previously saved data) and matches any data reflecting one or more identical fixed coordinate in step 24. For example, where the plurality of fixed coordinates associated with a first location is determined to be 1, 2, 3 and the plurality of fixed coordinates associated with a second location is determined to be 2, 3, 5, the system 10 processes each of the plurality of fixed coordinates through the cryptographic algorithm, such as MD-5, and combines salt to the plurality of fixed coordinates in step 22, causing each resulting Processed Coordinate to be confidential. Then, the comparison between the resulting Processed Coordinates would identify the match of the respective Processed Coordinate

associated with the 2 and 3 of the plurality of fixed coordinates common between the first location and the second location.

[0020] Thereafter, the Processed Coordinates and any matches are stored in a database in step 26 and the system issues a signal (e.g., match or no match) based upon user-defined rules and policies in step 28, such as transferring the Processed Coordinates to other systems for analysis and coordination.

[0021] From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.